

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
02.01.2004 Bulletin 2004/01

(51) Int Cl.7: **H02K 1/27**

(43) Date of publication A2:
19.12.2001 Bulletin 2001/51

(21) Application number: **01304932.5**

(22) Date of filing: **06.06.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR
 Designated Extension States:
AL LT LV MK RO SI

(72) Inventors:
 • **Yamamoto, Tomonaga, Room 8-210**
Minamitsuru-gun, Yamanashi 401-0511 (JP)
 • **Maeda, Takuya, FANAC Dai3virakaramatsu**
Yamanashi 401-0511 (JP)

(30) Priority: **16.06.2000 JP 2000181190**

(74) Representative: **Billington, Lawrence Emlyn**
Haseltine Lake & Co.,
Imperial House,
15-19 Kingsway
London WC2B 6UD (GB)

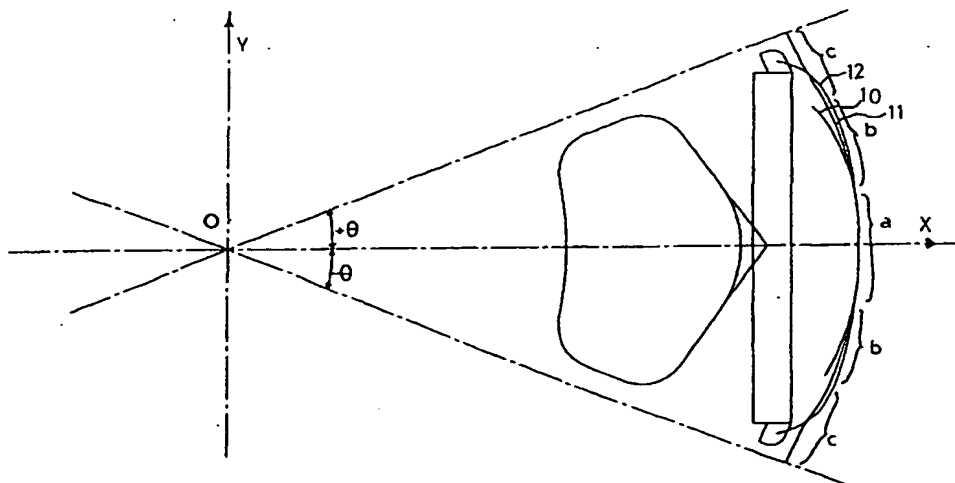
(71) Applicant: **FANUC LTD**
Minamitsuru-gun, Yamanashi 401-0597 (JP)

(54) **Rotor for synchronous motor**

(57) A rotor for a synchronous motor capable of increasing output torque and reducing inductance. An outer periphery of each pole of the rotor in cross section perpendicular to an axis of the rotor is defined on the basis of a curve of a hyperbolic function (10). Since an outer periphery of one pole of the rotor at a central apex portion (a) is substantially identical with that of a conventional rotor defined by a circular arc (11), the output

torque of the synchronous motor using this rotor is not decreased. At side portions (b) adjacent to the central apex portion (a), the outer periphery of the rotor pole is positioned inwardly, i.e. closer to the axis (O) of the rotor than the outer periphery defined by the circular arc (11), so that a gap between the outer periphery of the rotor pole and an inner periphery of a stator is made greater at the side portions (b) to reduce the inductance of the synchronous motor.

FIG. 6





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 30 4932

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	EP 0 392 028 A (FANUC LTD) 17 October 1990 (1990-10-17) * the whole document *	1-8	H02K1/27
Y	PATENT ABSTRACTS OF JAPAN vol. 015, no. 479 (E-1141), 5 December 1991 (1991-12-05) & JP 03 207256 A (SHINKO ELECTRIC CO LTD), 10 September 1991 (1991-09-10) * abstract *	1-8	
A	US 4 714 852 A (AMEMIYA YOICHI ET AL) 22 December 1987 (1987-12-22) * column 1, line 25 - line 37 * * column 2, line 34 - line 42 *	7	
A	EP 0 445 308 A (FANUC LTD) 11 September 1991 (1991-09-11) * column 1, line 33 - line 45 * * column 4, line 6 - line 58 * * figures 4,5 *	1-8	
A	US 4 748 360 A (AMEMIYA YOICHI ET AL) 31 May 1988 (1988-05-31) * column 1, line 10 - line 29 * * column 3, line 65 - column 5, line 11 *	1-8	
A	EP 0 365 689 A (FANUC LTD) 2 May 1990 (1990-05-02) * page 1, line 33 - line 35 * * page 6, line 27 - page 7, line 22 *	1-8	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) H02K
Place of search MUNICH		Date of completion of the search 5 November 2003	Examiner Mayer-Martin, E-M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 (2.12.1994)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 30 4932

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-11-2003

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 0392028	A	17-10-1990	JP	2111238 A	24-04-1990
			EP	0392028 A1	17-10-1990
			WO	9004875 A1	03-05-1990

JP 03207256	A	10-09-1991	JP	2785406 B2	13-08-1998

US 4714852	A	22-12-1987	JP	61058457 A	25-03-1986
			EP	0193611 A1	10-09-1986
			WO	8601651 A1	13-03-1986
			KR	9005810 B1	11-08-1990

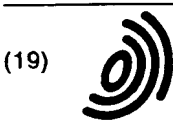
EP 0445308	A	11-09-1991	JP	3117338 A	20-05-1991
			EP	0445308 A1	11-09-1991
			WO	9105396 A1	18-04-1991

US 4748360	A	31-05-1988	JP	60121949 A	29-06-1985
			DE	3481883 D1	10-05-1990
			EP	0163747 A1	11-12-1985
			WO	8502726 A1	20-06-1985
			US	4661736 A	28-04-1987

EP 0365689	A	02-05-1990	JP	1278247 A	08-11-1989
			DE	68904728 D1	18-03-1993
			DE	68904728 T2	02-09-1993
			EP	0365689 A1	02-05-1990
			WO	8910653 A1	02-11-1989
			KR	9200685 B1	20-01-1992

EPO FORM P4439

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 164 684 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
02.01.2004 Bulletin 2004/01

(51) Int Cl.7: **H02K 1/27**

(43) Date of publication A2:
19.12.2001 Bulletin 2001/51

(21) Application number: **01304932.5**

(22) Date of filing: **06.06.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

(72) Inventors:
• Yamamoto, Tomonaga, Room 8-210
Minamitsuru-gun, Yamanashi 401-0511 (JP)
• Maeda, Takuya, FANAC Dai3virakaramatsu
Yamanashi 401-0511 (JP)

(30) Priority: **16.06.2000 JP 2000181190**

(74) Representative: **Billington, Lawrence Emlyn
Haseltine Lake & Co.,
Imperial House,
15-19 Kingsway
London WC2B 6UD (GB)**

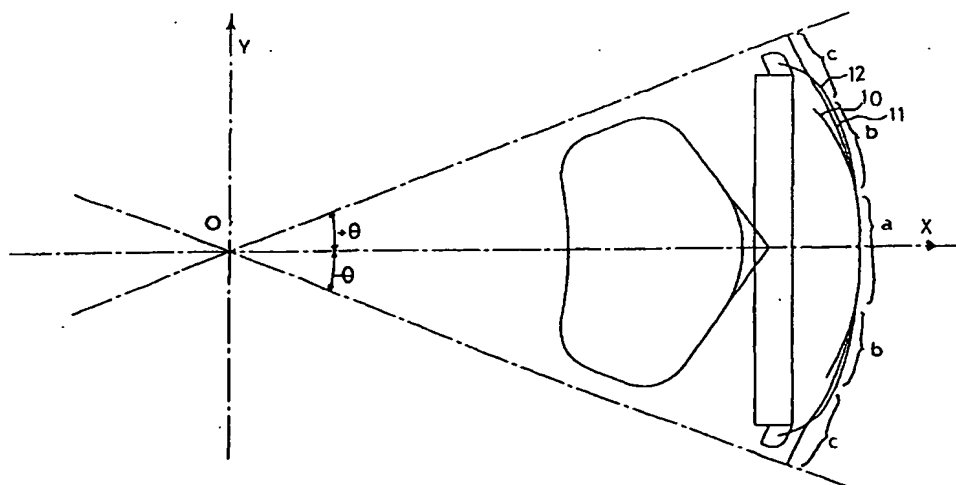
(71) Applicant: **FANUC LTD
Minamitsuru-gun, Yamanashi 401-0597 (JP)**

(54) **Rotor for synchronous motor**

(57) A rotor for a synchronous motor capable of increasing output torque and reducing inductance. An outer periphery of each pole of the rotor in cross section perpendicular to an axis of the rotor is defined on the basis of a curve of a hyperbolic function (10). Since an outer periphery of one pole of the rotor at a central apex portion (a) is substantially identical with that of a conventional rotor defined by a circular arc (11), the output

torque of the synchronous motor using this rotor is not decreased. At side portions (b) adjacent to the central apex portion (a), the outer periphery of the rotor pole is positioned inwardly, i.e. closer to the axis (O) of the rotor than the outer periphery defined by the circular arc (11), so that a gap between the outer periphery of the rotor pole and an inner periphery of a stator is made greater at the side portions (b) to reduce the inductance of the synchronous motor.

FIG. 6



EP 1 164 684 A3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 30 4932

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	EP 0 392 028 A (FANUC LTD) 17 October 1990 (1990-10-17) * the whole document *	1-8	H02K1/27
Y	--- PATENT ABSTRACTS OF JAPAN vol. 015, no. 479 (E-1141), 5 December 1991 (1991-12-05) & JP 03 207256 A (SHINKO ELECTRIC CO LTD), 10 September 1991 (1991-09-10) * abstract *	1-8	
A	--- US 4 714 852 A (AMEMIYA YOICHI ET AL) 22 December 1987 (1987-12-22) * column 1, line 25 - line 37 * * column 2, line 34 - line 42 *	7	
A	--- EP 0 445 308 A (FANUC LTD) 11 September 1991 (1991-09-11) * column 1, line 33 - line 45 * * column 4, line 6 - line 58 * * figures 4,5 *	1-8	
A	--- US 4 748 360 A (AMEMIYA YOICHI ET AL) 31 May 1988 (1988-05-31) * column 1, line 10 - line 29 * * column 3, line 65 - column 5, line 11 *	1-8	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H02K
A	--- EP 0 365 689 A (FANUC LTD) 2 May 1990 (1990-05-02) * page 1, line 33 - line 35 * * page 6, line 27 - page 7, line 22 *	1-8	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 5 November 2003	Examiner Mayer-Martin, E-M
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 (03.02) (P04CO-1)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 30 4932

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-11-2003

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 0392028	A	17-10-1990	JP	2111238 A	24-04-1990
			EP	0392028 A1	17-10-1990
			WO	9004875 A1	03-05-1990

JP 03207256	A	10-09-1991	JP	2785406 B2	13-08-1998

US 4714852	A	22-12-1987	JP	61058457 A	25-03-1986
			EP	0193611 A1	10-09-1986
			WO	8601651 A1	13-03-1986
			KR	9005810 B1	11-08-1990

EP 0445308	A	11-09-1991	JP	3117338 A	20-05-1991
			EP	0445308 A1	11-09-1991
			WO	9105396 A1	18-04-1991

US 4748360	A	31-05-1988	JP	60121949 A	29-06-1985
			DE	3481883 D1	10-05-1990
			EP	0163747 A1	11-12-1985
			WO	8502726 A1	20-06-1985
			US	4661736 A	28-04-1987

EP 0365689	A	02-05-1990	JP	1278247 A	08-11-1989
			DE	68904728 D1	18-03-1993
			DE	68904728 T2	02-09-1993
			EP	0365689 A1	02-05-1990
			WO	8910653 A1	02-11-1989
			KR	9200685 B1	20-01-1992

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82